

SECTION 2. BACKGROUND ISSUES

The background issues described in this section are important for interpreting the literature on women in academic careers. These include human capital and occupational choice theory, the kinds of data that are typically used in empirical research on the effects of gender on academic careers, and selection issues that complicate interpreting the results of empirical research.

HUMAN CAPITAL THEORY AND OCCUPATIONAL CHOICE

Human capital is the set of skills and abilities that enable individuals to perform jobs. Individuals can acquire or add to their stock of human capital through education and training. Economic theory suggests that individuals invest in education and training to realize the expected future benefits of both earnings and nonpecuniary amenities associated with employment.

Clearly, individuals with doctoral degrees have made substantial investments in human capital. These investments include the direct costs of education plus the opportunity costs of earnings forgone during schooling.

Individuals can also accumulate human capital through on-the-job experience. For example, doctorate earners might reasonably be expected to improve both their research and their teaching skills with experience, particularly during the early years of their employment. Even within academics, different jobs lead to the formation of qualitatively different human capital. For example, an individual who takes employment in an academic department that stresses research is likely to acquire skills quite different from an individual who works at a teaching institution.

One issue raised in the literature is whether women and men acquire qualitatively and quantitatively different levels of human capital because of family and parental responsibilities. One hypothesis is that human capital accumulated by female scientists and engineers depreciates when childbearing and child rearing interrupts their careers (or alternatively, that women accumulate human capital at a slower rate than men do because parental responsibilities interrupt their participation in the workforce). A second hypothesis, advanced by Johnson and Stafford (1974), argues that women have less incentive to accumulate human capital than men do because child rearing leaves them with less time to realize re-

turns on their investments. Johnson and Stafford argued that the tendency of women to take jobs at teaching rather than research institutions reflects occupational choices that trade human capital accumulation for short-term economic benefits.⁴

Some have criticized the emphasis on human capital theory in the literature. Strober and Quester (1977), for example, discounted Johnson and Stafford's argument that women's job choices reflect deliberate decisions to forgo human capital investments in favor of short-term economic gains. Colander and Woos (1997) argued that emphasis on differences between men's and women's human capital diverts attention from demand-side discrimination against women. They argued that lower pay for women faculty allows established academic "insiders" to capture economic rent.

DATA

Data requirements generally depend on the objectives and design of a particular study. However, if the objective is to measure the effects of gender on the careers of academic scientists and engineers, some general data requirements can be identified. First, measures of career outcomes are required, for example, earnings and academic rank.

In addition to measures of outcomes, well-designed studies of gender effects require data on control variables that might be expected to affect outcomes. These include measures of productivity (e.g., number of publications) and human capital (e.g., quality of graduate program attended, years of experience).⁵ Also, many of the studies we reviewed contain variables reflecting personal characteristics that might affect outcomes, including age, marital status, number of children, and race/ethnicity.

Generally, the studies we reviewed used two kinds of data—data that are national in scope and data from single academic institutions. An obvious advantage of using national data sets is the ability to generalize results of studies to the national population. However, some

⁴Johnson and Stafford argued that starting pay at less prestigious institutions that emphasize teaching is higher than at more prestigious research institutions.

⁵We might argue that career outcomes should depend strictly on productivity. However, given the difficulty of measuring productivity in academia, many studies include variables reflecting human-capital accumulation as controls.

of the single-institution data sets used in the literature contain detailed measures of control variables, especially those reflecting human capital and productivity.

Two national data sets used frequently in the literature are data collected and maintained by the National Science Foundation (NSF) and by the Carnegie Foundation for Advancement of Teaching. Salary studies by NSF (1996), Johnson and Stafford (1974), and Farber (1977) used NSF data. Also, Long (2001), Olson (1999), Kahn (1993), and Weiss and Lillard (1982) used NSF data to study the effects of gender on academic rank.

The Carnegie Foundation data include relatively detailed information on outcome measures, such as salary and academic rank, and on several control variables, including sociodemographic characteristics (gender, race, marital status, and children), employment history, time spent on teaching and research, and productivity (articles and books published). Ashraf (1996), Bellas (1993), Carnegie Foundation (1990), and Barbezat (1987, 1989b) used Carnegie Foundation data for studies on gender earnings gaps.

In addition to the data described above, some researchers used national data sets that are limited to specific fields. For example, Macfarlane and Luzzadder-Beach (1998) and Ongley et al. (1998) both used data maintained by the American Geological Institute for studies of academic rank. Several authors, including Brennan (1996), Everett et al. (1996), Heylin (1989), and Reskin (1976) used data from the American Chemical Society. Winkler et al. (1996) used data from the American Meteorological Society in a salary study.

Some authors have designed their own national databases for their studies. For example, Broder (1993) drew a sample from applications for NSF grants to study the effects of gender on the salaries and rank of academic economists, and Formby et al. (1993) conducted a national survey of economic departments for a salary study. Both the Broder and the Formby et al. data, however, are limited to a single academic field. Broder acknowledged that her sample from NSF grant applications might not be nationally representative, and the Formby et al. survey yielded only 258 responses from a sample of 469.

The National Center for Education Statistics has been conducting the National Study of Postsecondary Faculty (NSOPF) every five years since 1988. NSOPF is a nationally representative survey of faculty that contains data on career outcomes and numerous control variables, in-

cluding sociodemographic characteristics, teaching and research responsibilities, and scholarly productivity. Kirshstein et al. (1997) used data from the 1993 NSOPF in their study of women and minority faculty in science and engineering.

Numerous studies in the literature used data from single academic institutions. As noted above, some of the data assembled for these studies are richly detailed. For example, Raymond et al. (1988) and Ferber et al. (1978) constructed detailed measures of relative productivity (publications and research awards) by individual academic departments for their salary studies. Katz (1973) included measures of teaching quality and service to the academic community as well as detailed measures of scholarship in his study of salary at a large public university.

Longitudinal data that track individuals over time are useful for analyzing time between promotions and salary increases. However, relatively few of the studies we reviewed used longitudinal data. Farber (1977), who used NSF data,⁶ and Megdal and Ransom (1985), who used data from a single institution to study salary increases, are exceptions.

SELECTION ISSUES

Occupational choice theory states that individuals select jobs that give them the largest expected future benefits; however, the feasible set of employment opportunities from which individuals make choices is constrained. Perhaps most obviously, an individual's endowment of human capital limits available choices. For example, employment opportunities at top research universities are typically available only to the most able of those with doctoral degrees, who have demonstrated high levels of academic achievement. Discrimination can also affect job choices. Gender bias, for example, can either limit the set of job opportunities available to women or make some jobs less attractive because of lower pay or reduced promotion possibilities.⁷

There is substantial evidence in the literature that female and male scientists and engineers take academic jobs that are qualitatively different. Brennan (1996) reported that women are underrepresented at research universities, and the Carnegie Foundation (1990) found a

⁶ Farber used NSF panel data from 1960 through 1966.

⁷The literature provides some evidence that perceived discrimination affects job choices. Neumark and McLennan (1995) reported evidence that women who report acts of discrimination are more likely to change jobs.

concentration of women at lower-paying institutions. Koplin and Singell (1996) and Broder (1993) reported that female economists tend to be employed in less-prestigious departments. Barbezat (1992) found that women tend to be employed in academic jobs that stress teaching over research. There is also evidence that women and men tend to select different academic fields. Olson (1999) found that women are overrepresented in biology.

Barbezat (1992) conducted a survey of the employment preferences of individuals with doctorates in economics entering the job market. She found that salary and benefits are more important to men than they are to women. Women, however, place a higher preference than men do on student quality, teaching load, collegiality and interaction within academic departments, opportunities for joint work, and female representation on the faculty. Women also prefer spending more time teaching,⁸ whereas men prefer research. Barbezat found that after controlling for differences in stated job preferences, gender has no effect on actual employment placements.

We emphasize that Barbezat's findings are limited to first jobs in a single field. Moreover, preferences stated by the survey subjects may be, to some extent, rationalizations of employment opportunities. In short, whether male-female differences in employment outcomes result from differences in job preferences or from limited opportunities as a consequence of discrimination is unclear.

The evidence cited above suggests that employment outcomes for scientists and engineers in academia are not randomly distributed. More likely, they reflect the combined selection forces of human capital accumulation, job preferences, and limited opportunities. Selection has important implications for interpreting the results of empirical research on the effects of gender on employment outcomes in academic labor markets. For example, if gender differences in employment at teaching and research institutions are partly the result of discrimination, then controlling for the characteristics of the employing institution in a salary study will mask the effects of limited employment opportunities for women. Similarly, if women are underrepresented in higher academic ranks because of disparate treatment, controlling for rank in a salary study will understate the effects of gender on earnings.⁹ In theory, these types of selection

⁸Women's preferences for teaching are consistent with findings reported in Zuckerman et al. (1991).

⁹Gender discrimination in promotions would leave a pool of more qualified women in lower ranks and only the most highly qualified women in senior ranks.

biases can be reduced with appropriate controls for human capital and productivity. In practice, however, empirical measures of both are imperfect and incomplete.

PERCEPTIONS OF DISCRIMINATION

Several studies suggest a widespread feeling among women in academics that their gender is a roadblock to their careers. These analyses of surveys and case studies indicate that women find that their gender limits career advancement (Brennan, 1992); women feel marginalized and excluded from a significant role in their departments (MIT 1999); women in the junior faculty ranks are more frustrated than men by the publishing review process; women lack practical applications for their research, respect from colleagues, and networking in their field (Macfarlane and Luzzadder-Beach, 1998); and women face more difficulties reaching tenure because of interruptions in their careers from childbearing (Brennan, 1996).

A few studies have linked measures of job satisfaction or perceptions of discrimination to career outcomes. One kind of model examines the relations between different outcomes (tenure status or wage differentials) and overall job satisfaction. A second kind of model examines the effect of job satisfaction on the likelihood of job retention and consequently on tenure.

For example, Hagedorn (1995), using a national database of faculty members in all fields, first estimated a gender-based wage differential and then incorporated the estimates into a causal model to predict several job-related measures of satisfaction. She found that the estimated wage differential has significant effects on women's perceptions of the employing institution, stress level, global job satisfaction, and intent to remain in academia.

Neumark and McLennan (1995) used data from the national Longitudinal Survey of Young Women to test a "feedback" hypothesis,¹⁰ an alternative to the human capital explanation of gender differences in wages. Their findings only partially support this hypothesis. They found that working women who report discrimination are subsequently more likely to change employers, to marry, and to have children. However, they also found that there is no relationship between self-reported discrimination and the subsequent accumulation of labor-

¹⁰The feedback hypothesis is that women experience labor-market discrimination and respond with career interruptions, less investment, and lower wage growth.

market experience and that women reporting sex discrimination do not subsequently have lower wage growth.

Using 1993 data from the National Survey of Post-secondary Faculty to investigate the direct and indirect effects of gender on job satisfaction, Busenberg (1999) concluded that gender affects job satisfaction among aca-

demic scientists both directly and indirectly through mediating variables. In addition, Busenberg found that the extrinsic aspects of employment are much more significant than intrinsic aspects in predicting overall job satisfaction among scientists and that research productivity is only indirectly predicted by gender.